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## **Air Emissions Inventory for Selected Maryland National Guard Sources**

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The Clean Air Act Amendments of 1990 (CAAA-90) as well as other Federal, State, and local programs have expanded the requirements to quantify and report the amount of air pollutant emissions released into the atmosphere. The quantification of air pollutant emissions from a commercial facility, such as a military installation, is accomplished by conducting an air emissions inventory (AEI).

The Army National Guard of the State of Maryland would like to be proactive with an air emission program. Air Emission Inventories of Maryland National Guard facilities are needed to verify whether the facilities are considered major air pollution sources and therefore need to comply with Title V Permits and Risk Management Plans.

This study provides a scientific approach to estimating the air emissions from stationary sources at selected Maryland National Guard sites.

Researchers and staff at the Maryland National Guard Environmental Branch selected 13 armories as sites for Air Emissions Inventories. The researchers evaluated a number of methods for quantifying air pollutants and selected "emission factors" as the method of estimating emissions.



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## Foreword

This study was conducted for the Maryland National Guard, Facilities Management Office/Environmental Branch, Fifth Regiment Armory under Reimbursable Project number 88IP18MD999095, "Air Regulatory Compliance Documentation and Reporting for Maryland National Guard," Work Unit W58 "Air Emissions Inventory." The technical monitor was Captain Chris Cole.

Special thanks to Mrs. Ruth McCuin, Assistant Air Monitoring Supervisor for her valuable assistance during this study.

The work was performed by the Environmental Processes Branch (CN-E) of the Installations Division (CN), and the Energy Branch (CF-E) of the Facilities Division (CF), Construction Engineering Research Laboratory (CERL). The CERL Principal Investigator was Bernard A. Donahue. L. Jerome Benson is Chief, CEERD-CN-E, and Dr. John T. Bandy is Chief, CEERD-CN. Mr. Paul Nielsen is a member of the Energy Branch (CF-E). Larry M. Windingland is Chief, CEERD-CF-E, and L. Michael Golish is Chief, CEERD-CF. The technical editor was Gloria J. Wienke, Information Technology Laboratory.

The Director of CERL is Dr. Michael J. O'Connor.

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# 1 Introduction

## Background

The Clean Air Act Amendments of 1990 (CAAA-90) as well as other Federal, State, and local programs have expanded the requirements for industry to quantify and report the amount of air pollutant emissions released into the atmosphere. These regulatory programs have also increased the number of pollutants that must be evaluated and considered by industrial facilities.

The quantification of air pollutant emissions from a commercial facility, such as a military installation, is accomplished by conducting an air emissions inventory (AEI). An AEI is defined as a compilation of pollutant emissions over a given period of time, typically 1 year.

The Army National Guard of the State of Maryland would like to be proactive with an air emission program. The Environmental Branch of the Facilities Management Office asked the Construction Engineering Research Laboratory (CERL) to provide an up-to-date inventory of possible air pollution sources at National Guard installations and a software kit that can calculate air emissions for state permits if they are needed in the future. Although many Army installations are classified as industrial facilities, National Guard sites are generally classified as commercial facilities.

Air Emission Inventories of Maryland National Guard facilities are needed to verify whether the facilities are considered major air pollution sources and therefore need to comply with Title V Permits and Risk Management Plans.

## Objective

The objective of this study was to provide a scientific approach to estimating the air emissions from stationary sources at selected Maryland National Guard sites.

## Approach

CERL researchers and the staff at the Maryland National Guard Environmental Branch selected 13 armories as sites for Air Emissions Inventories. The researchers evaluated a number of methods for quantifying air pollutants and selected "emission factors" as the method of estimating emissions.

To estimate combustion emissions, researchers used a program called i-STEPS. This commercially available program is based on requirements for emissions reporting to the U. S. Environmental Protection Agency (EPA). To estimate storage tank emissions, researchers used the EPA's TANKS, version 4.05 computer program.

The following 13 armories were selected to represent different areas throughout the State of Maryland.

- Cade Armory and Maintenance Shop
- Chestertown Armory and Maintenance Shop
- Cumberland Armory and Maintenance Shop
- Dundalk Armory and Maintenance Shop
- Ellicott City Maintenance Shop
- Fifth Regiment Armory
- Hagerstown Armory and Maintenance Shop
- Salisbury Armory and Maintenance Shop
- White Oak Armory and Maintenance Shop
- Camp Fretterd Military Reservation
- Gunpowder Armory
- Havre De Grace State Military Reservation and Maintenance Shop
- Pikesville Military Reservation and Maintenance Shop

## Scope

This study focuses only on criteria pollutants. These are the only pollutants of interest to National Guard sites, based on their mission (non-industrial).

## Mode of Technology Transfer

The information in this report, and the external combustion data gathered in this study, will be provided to the Maryland National Guard in the i-STEPS format on a computer disk to allow other facilities to be added and for data entry for subsequent years.

## 2 Air Emissions Inventory

When conducting an Air Emissions Inventory at a military installation, the amount of regulated pollutants emitted from all emission sources located at the commercial facility (except those sources that are specifically exempt) must be determined. Several methods can be used to quantify air pollutants from emission sources including:

- Continuous emissions monitoring and/or stack sampling
- Emission factors
- Material balances
- Process-specific empirical relationships
- Engineering estimates.

Of these methods, monitoring/sampling is the most accurate since the measurements are taken directly from the source. This method should be used whenever possible. However, for most emission sources, it is too costly to gather monitoring or sampling data. In these cases, the use of published emission factors and/or material balance calculations are the most common methods used to estimate emissions. For this study, emission factors are the most efficient and least costly method of estimating emissions and are the methods specified in this document.

In general, emission factors are "typical" values applicable to a specific source type. These values are usually expressed as the weight of pollutant emitted per a certain unit weight, volume, distance, or duration associated with the activity emitting the pollutant (e.g., pounds of particulate emitted per ton of coal burned by a boiler).

### Pollutants

Although there are several types (groups/classes) of Federal and State regulated pollutants that may be evaluated in an AEI, this research focuses on a group called "criteria pollutants." Criteria pollutants are usually referred to as the pollutants for which the Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS); they include carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter with an aerodynamic di-

ameter equal to or less than 10 microns, and sulfur oxides. The list of "criteria pollutants" for emissions (and emissions inventory) purposes is slightly different than the pollutants regulated by NAAQS.

Criteria pollutants for air emissions inventory purposes include the following:

- Carbon Monoxide (CO)
- Nitrogen Oxides (NO<sub>x</sub>)
- Particulate Matter with an aerodynamic diameter less than or equal to 10 microns (PM<sub>10</sub>)
- Total Particulate Matter (PT)
- Sulfur Oxides (SO<sub>x</sub>)
- Volatile Organic Compounds (VOC).

Although lead is a criteria pollutant under the NAAQS, it is not included in the AEI because it is illegal now to put lead in fuel and there would be no air emissions from lead. Ozone is created in the atmosphere (ambient air) through a photochemical reaction involving the following two precursors: volatile organic compounds (VOC) and nitrogen oxides (NO<sub>x</sub>). Nitrogen dioxide (NO<sub>2</sub>) in the ambient air is a result of emissions of various nitrogen oxide (NO<sub>x</sub>) compounds, not just NO<sub>2</sub>.

## Inventory Data Elements and Format

To calculate the emissions needed to compile an AEI, certain input information is required. For example, to calculate the emissions from a boiler the following information is needed:

1. Make, model number, and manufacturer of combustion unit.
2. Actual emissions (stack) sampling results, if available.
3. Type of fuel(s) burned during the year (e.g., bituminous coal, anthracite coal, fuel oil [No. 6, No. 5, No. 4, or distillate], natural gas, liquified petroleum gas [propane or butane]) by the combustion unit.
4. If coal fired, the exact type of boiler/furnace (e.g., pulverized coal, dry bottom, wall fired; pulverized coal, dry bottom, tangentially fired; pulverized coal, wet bottom; cyclone furnace; spreader stoker; overfeed stoker; underfeed stoker; hand-fed unit; fluidized bed combustor, circulating bed; fluidized bed combustor, bubbling bed; etc.).
5. If coal fired, the typical ash content and sulfur content of the coal (wt%).
6. If fuel oil fired, the typical sulfur content of the fuel oil (wt%).
7. Rated capacity of the combustion unit (MMBtu/hr).
8. Amount of each fuel type burned during the year in the combustion unit.
9. Amount of time (hours) the combustion unit was operated during the year.
10. Type of control device(s) used for the combustion unit, if applicable (e.g., multiple cyclone, scrubber, electrostatic precipitator [ESP], bag house, etc.).
11. Make, model number, and manufacturer of each control device.



12. Type of control technique(s) used for the combustion unit, if applicable (e.g., low NO<sub>x</sub> burners, flue gas recirculation, low excess air, burners out of service, selective noncatalytic reduction, selective catalytic reduction, overfire air, etc.).

To calculate the emissions from a storage tank, the following information is needed:

1. Shell length (ft).
2. Diameter (ft).
3. Working volume (gal).
4. Number of turnovers per year.
5. Is tank underground (yes or no).
6. Is tank heated (yes or no).
7. If tank is heated, what is the average liquid surface temperature (degrees F).
8. Shell color/shade (choose one of the following: white/white, aluminum/specular, aluminum/diffuse, gray/light, gray/medium, or red/primer).
9. Shell condition (good or poor).
10. Breather vent vacuum setting (the default in the Environmental Protection Agency's TANKS software is -0.03 psig).
11. Breather vent pressure setting (TANKS default is 0.03 psig).
12. Nearest major city (choose from list in TANKS program).
13. Chemical category of liquid stored in tank (choose one: organic liquid, petroleum distilled, or crude oil).
14. Is liquid a single or multi-component liquid? (Note: fuels are considered "single" component liquids).
15. Name of liquid or liquid components. (Note: TANKS contains lists of various chemicals and fuels to choose from. For JP-8, the "jet kerosene" option is typically used).
16. Weight percent of components (for multi-component liquids).

## Inventory Requirements and Uses

Air emissions inventories are usually accomplished to meet one or more regulatory requirements. The most common regulatory requirements for conducting an AEI are summarized in the following paragraphs.

### ***Title I of the CAAA-90***

The Clean Air Act (CAA) requires each State to develop a State Implementation Plan (SIP) for attaining and maintaining NAAQS. Per Title I of the CAAA-90, SIPs must include provisions for States to submit emissions inventories to the EPA and for sources to submit emissions inventories to the State. The following paragraphs summarize inventory requirements implemented by Title I of the CAAA-90.

- According to Section 172 of the CAA, each State must include a current inventory of each criteria pollutant whenever an SIP revision is submitted to

the EPA. The inventory of each pollutant will only include actual emissions from sources located in areas that are in nonattainment for that particular pollutant. (Note: for ozone nonattainment areas, this would include an inventory of VOCs and NO<sub>x</sub>).

- Section 182(a)(1) of the CAA required each State to submit to the EPA by November 1992, a current inventory of actual VOCs and NO<sub>x</sub> emissions (from sources in areas that are in nonattainment for ozone) and of actual CO emissions (from sources in areas that are in nonattainment for CO). This inventory included emissions for calendar year 1990 and is referred to as the baseline year emissions inventory. Subsequent to the baseline inventory, each State must submit periodic inventories every 3 years until the area within the state reaches attainment.
- Section 182 of the CAA also required each State to submit SIP revisions (by 15 November 1992) requiring stationary sources in ozone nonattainment areas to report their actual VOC and NO<sub>x</sub> emissions to the State by 15 November 1993 and annually thereafter. (Note: A State may waive this requirement for sources that emit less than 25 tons per year of VOC or NO<sub>x</sub>).

### ***Title III of the CAAA-90***

Under Title III of the CAAA-90 (Section 112 of the CAA), the EPA is required to promulgate National Emissions Standards for Hazardous Air Pollutants (NESHAPs) to regulate certain source categories that emit HAPs. Some of these NESHAPs, such as the Aerospace Manufacturing and Rework NESHAP, only apply to sources that are considered to be a "major source" for HAPs. A major source for HAPs is defined as any stationary source or group of stationary sources located within a contiguous area and under common control that emits or has potential to emit over 10 tons per year (tpy) of any single HAP or over 25 tpy of any combination of HAPs. In order for a source (e.g., military installation) to determine if it is a major source for HAPs, an inventory of HAP emissions must be accomplished.

### ***Title V of the CAAA-90***

Under Title V of the CAAA-90 (and Title V of the CAA), all stationary sources that are classified as a "major source" are required to obtain a Title V operating permit. A major source under Title V includes the following:

- A major source under Section 112 of the Clean Air Act (i.e., a major source for HAPs).
- A stationary source (or group of stationary sources that are located on one or more contiguous properties, are under common control, and belong to the same two-digit Standard Industrial Classification code) that emits more than 100 tpy of any air pollutant (as defined under section 302(g) of the CAA). For some of the criteria pollutants, lower limits exist for certain nonattainment areas. These lower limits include the following:

- 50 tpy of VOC and NO<sub>x</sub> emissions in "serious" ozone nonattainment areas and in ozone transport regions.
- 25 tpy of VOC and NO<sub>x</sub> emissions in "severe" ozone nonattainment areas.
- 10 tpy of VOC and NO<sub>x</sub> emissions in "extreme" ozone nonattainment areas.
- 50 tpy of CO emissions in "serious" CO nonattainment areas.
- 70 tpy of PM<sub>10</sub> emissions in "serious" PM<sub>10</sub> nonattainment areas.

For a source (e.g., military installation) to determine if it is a major source under Title V, an emissions inventory (of actual and potential emissions) must be accomplished. It is important to note that with the exemption of the HAPs regulated under Title III, when making a major source determination under Title V, you do not need to include fugitive emissions unless the emissions come from one of the 27 source categories listed in 40 CFR 70.2. However, if a Title V permit is required, then fugitive emissions need to be included in the permit application.

### ***Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA)***

EPCRA Section 313 (40 CFR 372) contains a list of over 680 toxic chemicals and requires facilities to submit annual Toxic Release Inventory (TRI) reports for all chemicals that are either manufactured/processed or otherwise used at the facility above threshold levels. These threshold levels include the following:

- 25,000 pounds for any chemical manufactured or processed at the facility during the year, or
- 10,000 pounds for any chemical otherwise used at the facility during the year.

For any chemicals above the threshold levels, the facility must submit an EPA Form R, which specifies the amount of the chemical that was released to the environment (via air, water, and land). The amount released to the air is usually obtained from emissions inventory data. Although this form does not specifically address the EPCRA Section 313 chemicals, most of the chemicals that are applicable to the National Guard are also on the list of HAPs (e.g., methyl ethyl ketone, toluene, methyl chloroform, methylene chloride, phenol, etc).

### ***General Conformity***

The general conformity program (found in 40 CFR 93) requires all Federal actions in nonattainment and maintenance areas to comply with the appropriate SIP. The Federal agency responsible for the action is required to perform a determination to verify that the action(s) conform. An emissions inventory is usually required as part of the conformity determination to identify/quantify air emissions from the Federal actions.

### ***National Environmental Policy Act (NEPA)***

NEPA requires Federal agencies to evaluate the environmental impacts associated with major actions that they either fund, support, permit, or implement. As part of the NEPA process, an Environmental Assessment (EA) is required if it is determined that the Federal action may have a significant environmental impact. The EA is a study submitted to the EPA that provides background information and preliminary analyses of the potential impact of the proposed Federal action. If the results of the EA indicate that further study of the proposed action is necessary, then a more comprehensive Environmental Impact Statement (EIS) must be prepared. The EIS addresses all possible impacts (both beneficial and adverse) that may result from the proposed action as well as possible alternatives to the action. Data from air emissions inventories can be used in EAs and EISs to help identify possible environmental consequences associated with air emissions from proposed Federal actions.

### ***State/Local Programs***

Some State and local regulatory agencies have unique programs that require some sort of air emissions inventory. These unique programs are important and must not be overlooked.

### **Potential to Emit (PTE)**

A source's potential to emit (PTE) is an essential part of an air emissions inventory. Potential emissions are used to categorize a source as either "major" or "minor" for criteria air pollutants and either "major" or "area" for hazardous air pollutants. Avoiding major source status can save a facility money in manpower costs, equipment modifications, and fees.

The EPA's definition for PTE according to 40 CFR 70.2 is: "the maximum capacity of a stationary source to emit any air pollutant under its physical and operational design. Any physical or operational limitation on the capacity of a source to emit an air pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored or processed shall be treated as part of its design if the limitation is enforceable by the Administrator." As a result, many sources currently interpret the PTE definition to mean 24 hour a day operation, 365 days a year (or 8,760 hrs/yr). For most of these sources, this is an invalid assumption and results in an overestimation of potential emissions.

With few exceptions, the emission sources on National Guard installations are related to external combustion and fuel storage and are not operated 8,760 hours per year. The PTE calculations for each of these categories will be discussed in the following paragraphs.

### ***External Combustion***

External combustion sources include boilers, furnaces, and heaters used for power production and/or heating. Most small external combustion units are located at individual buildings on base (e.g., in building mechanical rooms), while larger boilers are usually located at the installation heat plant. The emissions from external combustion units depend on a variety of factors including the type/size of combustor, firing configuration, fuel type, control devices used, operating capacity, and whether the system is properly operated/maintained.

The potential to emit has traditionally been calculated by assuming a boiler operates at peak capacity (maximum heat input capacity) for 8,760 hrs/yr. This is not a realistic assumption and results in an exaggerated PTE. A more realistic method for calculating PTE would take into consideration the real operating limitations of boilers and their schedules during the heating and air conditioning seasons. State and local regulatory officials may accept other PTE calculation methodologies from this source type. Each facility should actively pursue negotiations with regulators on alternative PTE calculation methods.

### ***Fuel Storage***

Storage tanks exhibit two types of losses: standing storage losses and working losses. The potential and actual emissions from standing storage losses will be equivalent since these losses are a function of the size and type of tank. The potential emissions from working losses, however, are determined by the potential fuel throughput.

Potential emissions from gasoline storage tanks are based on the maximum amount of fuel that may be dispensed in a given year. For military gasoline stations, the maximum potential number of government vehicles assigned to the installation can be used to determine the potential amount of fuel transferred. The process owner should be able to project the maximum number of government vehicles that could be assigned to the installation in the near future (i.e., in the next 5 years). The ratio of potential to actual number of government vehicles would be multiplied by the actual emissions to get potential emissions.

To determine potential emissions from non-gasoline (diesel) storage tanks, it is necessary to compare the actual number of vehicles assigned to the installation to the potential number of vehicles which may be assigned to the installation and apply this ratio to get the potential emissions.

### 3 Data Management

The data collected in this survey consisted of two types: external combustion sources (primarily heating facilities) and organic liquid storage tanks (motor fuels and heating fuel). The data on external combustion was processed using i-STEPS, an automated tool for storing, reporting, and managing air emissions data ([www.i-steps.com](http://www.i-steps.com)). This software organizes data files using the model prescribed by the EPA (AP 42 *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources*) for the storage and reporting of air data. Sections 1.3 Fuel Oil Combustion, 1.4 Natural Gas Combustion, and 1.5 Liquefied Petroleum Gas Combustion are the pertinent sections for the external combustion sources in this study. i-STEPS software does not calculate tank losses, however it has provisions for manual entry of this information. The tank losses were calculated using TANKS 4.05, a program obtained from the EPA Internet site: [www.epa.gov/ttn/chief](http://www.epa.gov/ttn/chief). Most of the data was gathered during site visits by CERL and Maryland National Guard headquarters personnel to the various Maryland National Guard sites.

#### i-STEPS, External Combustion Sources

External combustion fuels used by the Maryland National Guard include natural gas, propane, and fuel oil. Boilers are typically fired with fuel oil or natural gas. Natural gas or propane applications include distributed heating and water heating. No dual-fuel or coal-fired units were reported. The i-STEPS calculations are made using the yearly fuel usage quantity provided by the local installation. For this study, data was entered in a hierarchical fashion with the entire Maryland National Guard being regarded as one i-STEPS Facility, each location regarded as a Group, and each combustion source or building as a Process Unit.

A generic "stack" was defined and data for each combustion source was entered. The data entry process requires a sequential approach and identifies mandatory and optional data fields. (Dual fuel units would be entered as two Process Units.) The source classification code (SSC) number can be picked from a menu and after entering the annual use data, the emissions data is calculated. Reports with the entered information and the calculation results can be immediately examined for accuracy. The use of i-STEPS is relatively straightforward; reports can be printed directly from the program or can be exported as ASCII

files for editing by word processor software. The Appendix contains the results of the external combustion data gathered in this study and will be provided to the Maryland National Guard in the i-STEPS format on a computer disk to allow other facilities to be added and for data entry for subsequent years. A summary (Table 1) of the emissions calculated using I-STEPS indicates that the 13 facilities surveyed emit the following (total, in tons per year):

• CO – carbon monoxide	0.713
• NO <sub>2</sub> – nitrogen dioxide	2.714
• PM10 – particulate matter	0.168
• PT – total particulate matter	0.319
• SO <sub>2</sub> – sulfur dioxide	0.098
• VOC – volatile organic compounds	0.107

Title V of the CAAA-90 states that all stationary sources classified as “major sources” are required to obtain an operating permit. The most stringent major source is defined as 10 tpy of VOC and NO<sub>x</sub> emissions in “extreme” ozone nonattainment areas.

The total VOC and NO<sub>x</sub> calculated for all of the boilers at the 13 Maryland National Guard installations surveyed was about 2.8 tpy. The largest installation was Camp Fretterd, which contributed 0.638 tpy — well below the definition of a major source (see Appendix).

## Storage Tank Data

i-STEPS has a provision for entering storage tank data. However, it does not do the necessary calculations and when the tank source classification code is selected, the program asks that the calculated emissions data be entered. The program will then place the data in the proper location in its reports. Consequently, I-STEPS was not used to calculate storage tank emissions.

The techniques of AP-42, Section 7.1 Organic Liquid Storage Tanks were used for these calculations. A copy of TANKS 4.05 was downloaded from the EPA Internet site. It is available at no cost. The emission estimating equations used both for TANKS and AP-42 were developed by the American Petroleum Institute (API). API retains the copyright to these equations, but has granted permission for the nonexclusive, noncommercial distribution of this material to governmental and regulatory agencies. As a result, the TANKS program is available for public use, but the program cannot be sold without proper authorization. The principle variables of interest for these calculations are: tank size and dimensions, contents, and throughput. Secondary variables include location (used to



determine average liquid surface temperature) and tank color (to determine the solar insolation factor). The total losses from tanks are equal to the sum of the standing storage (or breathing) loss and the working loss. The standing loss is mainly a factor of tank location and geometry; the working loss is related to usage or turnover. The default values used by TANKS for the breather vent settings are: -0.03 psig for vacuum and 0.03 for pressure. The nearest large city can be chosen for meteorological data or more accurate local information (if available) can be entered. TANKS recommends the default use of the tank color white with the condition good if the color is unknown. Also recommended is the use of the nearest available color since not all tank colors are available.

The total VOC for all the tanks surveyed was 1,710 lbs per year (0.855 tpy). Of the total, 1,669 lbs was from the three tanks used to store gasoline.

**Table 1. Emission Summary by Source Classification Code (SCC)**

**MARYLAND NATIONAL GUARD**

**10500205 - Commercial/Institutional Space Heater**

**Distillate Oil**

<b>Pollutant</b>	<b>Estimated (TON/YR)</b>
CO - CARBON MONOXIDE	.5891760
NO2 - NITROGEN DIOXIDE	2.121006
PM10 - PARTICULATE MATTER 10	.1472930
PT - TOTAL PARTICULATE MATTER	.2945880
SO2 - SULFUR DIOXIDE	.0900980
VOC - VOLATILE ORGANIC COMPOUNDS	.0824840

**10500206 - Commercial/Institutional Space Heater**

**Natural Gas**

<b>Pollutant</b>	<b>Estimated (TON/YR)</b>
CO - CARBON MONOXIDE	.1064000
NO2 - NITROGEN DIOXIDE	.5320000
PM10 - PARTICULATE MATTER 10	.0159610
PT - TOTAL PARTICULATE MATTER	.0159610
SO2 - SULFUR DIOXIDE	.0031920
VOC - VOLATILE ORGANIC COMPOUNDS	.0281960

**10500210 - Commercial/Institutional Space Heater****Liquified Petroleum Gas (Lpg)**

<b>Pollutant</b>	<b>Estimated (TON/YR)</b>
CO - CARBON MONOXIDE	.0170000
NO2 - NITROGEN DIOXIDE	.0612000
PM10 - PARTICULATE MATTER 10	.0042500
PT - TOTAL PARTICULATE MATTER	.0085000
SO2 - SULFUR DIOXIDE	.0048820
VOC - VOLATILE ORGANIC COMPOUNDS	.0023800

**TOTALS**

<b>Pollutant</b>	<b>Estimated (TON/YR)</b>
CO - CARBON MONOXIDE	.7125700
NO2 - NITROGEN DIOXIDE	2.714200
PM10 - PARTICULATE MATTER 10	.167504
PT - TOTAL PARTICULATE MATTER	.3190490
SO2 - SULFUR DIOXIDE	.0981720
VOC - VOLATILE ORGANIC COMPOUNDS	.1068240

**39090003 - In-Process Fuel Use - Fuel Storage • Above Ground Storage Tanks**

Distillate Oil (No. 2), Diesel (No. 2): Standing Loss + Working Loss

<b>Pollutant</b>	<b>Estimated (LB/YR)</b>
VOC - VOLATILE ORGANIC COMPOUNDS	1710.05 (0.855 TON/YR)

**Table 2. Tank emissions summary.**

<b>Annual Emissions Report</b>				
<b>Tank Identification</b>				<b>Losses (lbs)</b>
Cade Armory	MD National Guard	Horizontal tank	Baltimore, MD	3.54
Camp Fretterd, Buldg 212	MD National Guard	Horizontal tank	Reistertown, MD	0.25
Camp Fretterd, Buldg 213	MD National Guard	Horizontal tank	Reistertown, MD	0.23
Camp Fretterd, Buldg 217	MD National Guard	Horizontal tank	Reistertown, MD	0.17
Camp Fretterd, Buldg 218, #1	MD National Guard	Horizontal tank	Reistertown, MD	0.26
Camp Fretterd, Buldg 218, #2	MD National Guard	Horizontal tank	Reistertown, MD	0.56

Annual Emissions Report				
Tank Identification				Losses (lbs)
Camp Fretterd, Buldg 218, #3	MD National Guard	Horizontal tank	Reistertown, MD	406.88
Camp Fretterd, Buldg 219, #1	MD National Guard	Horizontal tank	Reistertown, MD	2.19
Camp Fretterd, Buldg 219, #2	MD National Guard	Horizontal tank	Reistertown, MD	0.29
Camp Fretterd, Residence	MD National Guard	Horizontal tank	Reistertown, MD	0.15
Chesterton	MD National Guard	Horizontal tank	Chesterton, MD	4.36
Cumberland	MD National Guard	Horizontal tank	Baltimore, MD	0.98
Dundalk Armory #1	MD National Guard	Horizontal tank	Baltimore, MD	0.71
Dundalk Armory #2	MD National Guard	Horizontal tank	Baltimore, MD	0.56
Ellicott City #1	MD National Guard	Horizontal tank	Ellicott City, MD	0.79
Ellicott City #2	MD National Guard	Horizontal tank	Baltimore, MD	0.98
Ellicott City #3	MD National Guard	Horizontal tank	Ellicott City, MD	800.16
Gunpowder Military Reservation #1	MD National Guard	Horizontal tank	Baltimore, MD	1.43
Gunpowder Military Reservation #2	MD National Guard	Horizontal tank	Baltimore, MD	1.46
Hagerstown Armory #1	MD National Guard	Horizontal tank	Hagerstown, MD	1.95
Hagerstown Armory #2	MD National Guard	Horizontal tank	Hagerstown, MD	0.67
Havre de Grace, Bldg 1	MD National Guard	Horizontal tank	Havre de Grace	0.12
Havre de Grace, Bldg 2, #1	MD National Guard	Horizontal tank	Havre de Grace	464.79
Havre de Grace, Bldg 2, #2	MD National Guard	Horizontal tank	Havre de Grace	0.12
Havre de Grace, Bldg A1	MD National Guard	Horizontal tank	Baltimore, MD	0.55
Havre de Grace, Bldg S1	MD National Guard	Horizontal tank	Havre de Grace, MD	0.72
Havre de Grace, Bldg S1/W1	MD National Guard	Horizontal tank	Havre de Grace, MD	1.62
Havre de Grace, Bldg S2	MD National Guard	Horizontal tank	Havre de Grace, MD	0.23
Havre de Grace, Bldg S3	MD National Guard	Horizontal tank	Havre de Grace, MD	0.20
Parkville, Sherr Armory #1	MD National Guard	Horizontal tank	Baltimore, MD	1.19
Parkville, Sherr Armory #2	MD National Guard	Horizontal tank	Baltimore, MD	0.31
Pikesville, Admin Bldg	MD National Guard	Horizontal tank	Baltimore, MD	0.41
Pikesville, Cooper Bldg	MD National Guard	Horizontal tank	Baltimore, MD	2.97
Pikesville, GR13	MD National Guard	Horizontal tank	Baltimore, MD	0.06
Pikesville, MER	MD National Guard	Horizontal tank	Baltimore, MD	0.26
Pikesville, Vehicle Fuel	MD National Guard	Horizontal tank	Baltimore, MD	1.90
Pikesville, OMS-1	MD National Guard	Horizontal tank	Baltimore, MD	0.34
Ruhl Armory #1	MD National Guard	Horizontal tank	Towson, MD	1.60
Ruhl Armory #2	MD National Guard	Horizontal tank	Towson, MD	1.24
Salisbury, Main Armory	MD National Guard	Horizontal tank	Salisbury, MD	0.44
Salisbury, Vehicle Fuel #1	MD National Guard	Horizontal tank	Salisbury, MD	0.92
Salisbury, Vehicle Fuel #2	MD National Guard	Horizontal tank	Salisbury, MD	0.92
White Oak	MD National Guard	Horizontal tank	Silver Spring, MD	0.57
Total emissions for all tanks				1,710.05

## 4 Summary

Air emission inventories were conducted at 13 armories located throughout the State of Maryland. The air pollution sources consisted of external combustion boilers for heating purposes and the fuel storage tanks associated with the boilers as well as fuel storage tanks for vehicles.

The total VOC and NO<sub>x</sub> calculated for all of the boilers at the 13 Maryland National Guard installations surveyed was about 2.8 tpy. The largest installation was Camp Fretterd, which contributed 0.638 tpy — well below the definition of a major source (see Appendix).

The total VOC for all the tanks surveyed was 1,710 lbs per year (0.855 tpy). Of the total, 1,669 lbs was from the three tanks used to store gasoline.

## References

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- Clean Air Act Amendments of 1990, Public Law 101-54, November 15, 1990.
- i\_STEPS *infinity* computer program, *User's Manual, Version 3.2, Air Module*, Pacific Environmental Services, Inc., 5002 S. Miami Blvd., P.O. Box 12077, Research Triangle Park, NC 27709-2077. Information available online at [www.i-steps.com](http://www.i-steps.com)
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- 40 CFR 50, *National Primary and Secondary Ambient Air Quality Standards*.
- 40 CFR 70.2, *State Operating Permit Programs*, subparagraph 2, *Definitions*.
- 40 CFR 93, *Determining Conformity of Federal actions to State or Federal Implementation Plans*.
- 40 CFR 372, *Toxic Chemical Release Reporting: Community Right-To-Know*, also EPCRA - *Emergency Planning and Community Right-to-Know Act*, sec 313.

## Appendix A: External Combustion Data

### MARYLAND NATIONAL GUARD HEATING SYSTEM EMISSIONS

Annual  
(TPY)

LOCATION: CADE ARMORY

=====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.021228
NITROGEN	0.076419
PARTICULATE MATTER 10	0.005307
SULFUR DIOXIDE	0.003048
TOTAL PARTICULATE MATTER	0.010614
VOLATILE ORGANIC COMPOUNDS	0.002972

LOCATION: CHESTERTOWN ARMORY

=====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.015
NITROGEN DIOXIDE	0.054
PARTICULATE MATTER 10	0.00375
SULFUR DIOXIDE	0.002154
TOTAL PARTICULATE MATTER	0.0075
VOLATILE ORGANIC COMPOUNDS	0.0021

LOCATION: CUMBERLAND ARMORY

=====

PROCESS: NATURAL GAS FIRED BURNER

=====

CARBON MONOXIDE	0.1836
NITROGEN DIOXIDE	0.0918
PARTICULATE MATTER 10	0.002754
SULFUR DIOXIDE	0.000551
TOTAL PARTICULATE MATTER	0.002754
VOLATILE ORGANIC COMPOUNDS	0.004865

LOCATION: DUNDALK ARMORY MAINTENANCE SHOP

=====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.02125
NITROGEN DIOXIDE	0.0765
PARTICULATE MATTER 10	0.005313
SULFUR DIOXIDE	0.006103
TOTAL PARTICULATE MATTER	0.010625
VOLATILE ORGANIC COMPOUNDS	0.002975

## LOCATION: ELLICOTT CITY

## =====

PROCESS: 1 OIL FIRED BURNER

=====

CARBON MONOXIDE	0.019645
NITROGEN DIOXIDE	0.070722
PARTICULATE MATTER 10	0.004911
SULFUR DIOXIDE	0.002821
TOTAL PARTICULATE MATTER	0.009823
VOLATILE ORGANIC COMPOUNDS	0.002750

## LOCATION: FIFTH REGIMENT ARMORY

## =====

PROCESS: NATURAL GAS

=====

CARBON MONOXIDE	0.06637
NITROGEN DIOXIDE	0.33185
PARTICULATE MATTER 10	0.009956
SULFUR DIOXIDE	0.001991
TOTAL PARTICULATE MATTER	0.009956
VOLATILE ORGANIC COMPOUNDS	0.017588

## LOCATION: CAMP FRETTERD: BLDG 100, 101, 102

## =====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.017085
NITROGEN DIOXIDE	0.061506
PARTICULATE MATTER 10	0.004271
SULFUR DIOXIDE	0.002453
TOTAL PARTICULATE MATTER	0.008543
VOLATILE ORGANIC COMPOUNDS	0.002392

## BLDG 103

## =====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.00548
NITROGEN DIOXIDE	0.019728
PARTICULATE MATTER 10	0.00137
SULFUR DIOXIDE	0.000787
TOTAL PARTICULATE MATTER	0.00274
VOLATILE ORGANIC COMPOUNDS	0.000767

## BLDG 104

## =====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.007483
NITROGEN DIOXIDE	0.026937
PARTICULATE MATTER 10	0.001871
SULFUR DIOXIDE	0.001075
TOTAL PARTICULATE MATTER	0.003741
VOLATILE ORGANIC COMPOUNDS	0.001048

## BLDG 105

## =====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.02166
NITROGEN DIOXIDE	0.077976
PARTICULATE MATTER 10	0.005415
SULFUR DIOXIDE	0.003110
TOTAL PARTICULATE MATTER	0.01083
VOLATILE ORGANIC COMPOUNDS	0.003032

## BLDG 106

## =====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.00663
NITROGEN DIOXIDE	0.023868
PARTICULATE MATTER 10	0.001658
SULFUR DIOXIDE	0.000952
TOTAL PARTICULATE MATTER	0.003315
VOLATILE ORGANIC COMPOUNDS	0.000928

## BLDG 107

## =====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.006818
NITROGEN DIOXIDE	0.024543
PARTICULATE MATTER 10	0.001704
SULFUR DIOXIDE	0.000979
TOTAL PARTICULATE MATTER	0.003409
VOLATILE ORGANIC COMPOUNDS	0.000955

## BLDG 109

## =====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.005643
NITROGEN DIOXIDE	0.020313
PARTICULATE MATTER 10	0.001411
SULFUR DIOXIDE	0.000810
TOTAL PARTICULATE MATTER	0.002821
VOLATILE ORGANIC COMPOUNDS	0.00079

## BLDG 111

## =====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.002578
NITROGEN DIOXIDE	0.009279
PARTICULATE MATTER 10	0.000644
SULFUR DIOXIDE	3.70e-4
TOTAL PARTICULATE MATTER	0.001289
VOLATILE ORGANIC COMPOUNDS	3.61e-4



## BLDG 202

=====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.020045
NITROGEN DIOXIDE	0.072162
PARTICULATE MATTER 10	0.005011
SULFUR DIOXIDE	0.002879
TOTAL PARTICULATE MATTER	0.010023
VOLATILE ORGANIC COMPOUNDS	0.002806

## BLDG 203

=====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.01117
NITROGEN DIOXIDE	0.040212
PARTICULATE MATTER 10	0.002793
SULFUR DIOXIDE	0.001604
TOTAL PARTICULATE MATTER	0.005585
VOLATILE ORGANIC COMPOUNDS	0.001564

## BLDG 205

=====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.031078
NITROGEN DIOXIDE	0.111879
PARTICULATE MATTER 10	0.007769
SULFUR DIOXIDE	0.004463
TOTAL PARTICULATE MATTER	0.015539
VOLATILE ORGANIC COMPOUNDS	0.004351

## BLDG 211

=====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.022815
NITROGEN DIOXIDE	0.082134
PARTICULATE MATTER 10	0.005704
SULFUR DIOXIDE	0.003276
TOTAL PARTICULATE MATTER	0.011408
VOLATILE ORGANIC COMPOUNDS	0.003194

## BLDG 212

=====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.004003
NITROGEN DIOXIDE	0.014409
PARTICULATE MATTER 10	0.001001
SULFUR DIOXIDE	0.000575
TOTAL PARTICULATE MATTER	0.002001
OLATILE ORGANIC COMPOUNDS	0.000560

## BLDG 213

=====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.003825
NITROGEN DIOXIDE	0.01377
PARTICULATE MATTER 10	0.000956
SULFUR DIOXIDE	0.000549
TOTAL PARTICULATE MATTER	0.001913
VOLATILE ORGANIC COMPOUNDS	0.000536

## BLDG 217

=====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.002173
NITROGEN DIOXIDE	0.007821
PARTICULATE MATTER 10	0.000543
SULFUR DIOXIDE	3.12e-4
TOTAL PARTICULATE MATTER	0.001086
VOLATILE ORGANIC COMPOUNDS	3.04e-4

## BLDG 218

=====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.002868
NITROGEN DIOXIDE	0.010323
PARTICULATE MATTER 10	0.000717
SULFUR DIOXIDE	4.12e-4
TOTAL PARTICULATE MATTER	0.001434
VOLATILE ORGANIC COMPOUNDS	4.02e-4

## LOCATION: GUNPOWDER PURNELL ARMORY #100

=====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.017
NITROGEN DIOXIDE	0.0612
PARTICULATE MATTER 10	0.00425
SULFUR DIOXIDE	0.004882
TOTAL PARTICULATE MATTER	0.0085
VOLATILE ORGANIC COMPOUNDS	0.00238

## BUILDINGS 202,313, 311, 309

=====

PROCESS: PROPANE HEATERS

=====

CARBON MONOXIDE	0.017
NITROGEN DIOXIDE	0.0612
PARTICULATE MATTER 10	0.00425
SULFUR DIOXIDE	0.004882
TOTAL PARTICULATE MATTER	0.0085
VOLATILE ORGANIC COMPOUNDS	0.00238

## LOCATION: HAGERSTOWN ARMORY

## =====

PROCESS: 1 OIL FIRED BURNER

=====

CARBON MONOXIDE	0.03
NITROGEN DIOXIDE	0.108
PARTICULATE MATTER 10	0.0075
SULFUR DIOXIDE	0.004308
TOTAL PARTICULATE MATTER	0.015
VOLATILE ORGANIC COMPOUNDS	0.0042

## LOCATION: HAVRE DE GRACE STATE MILITARY RESERVATION: BLDG A1

## =====

PROCESS: FUEL OIL HEAT

=====

CARBON MONOXIDE	0.029975
NITROGEN DIOXIDE	0.10791
PARTICULATE MATTER 10	0.007494
SULFUR DIOXIDE	0.004304
TOTAL PARTICULATE MATTER	0.014988
VOLATILE ORGANIC COMPOUNDS	0.004197

## BLDG 01

## =====

PROCESS: FUEL OIL HEAT

=====

CARBON MONOXIDE	0.003244
NITROGEN DIOXIDE	0.011677
PARTICULATE MATTER 10	0.000811
SULFUR DIOXIDE	0.000466
TOTAL PARTICULATE MATTER	0.001622
VOLATILE ORGANIC COMPOUNDS	0.000454

## BLDG 02

## =====

PROCESS: FUEL OIL HEAT

=====

CARBON MONOXIDE	0.009894
NITROGEN DIOXIDE	0.035618
PARTICULATE MATTER 10	0.002473
SULFUR DIOXIDE	0.001421
TOTAL PARTICULATE MATTER	0.004947
VOLATILE ORGANIC COMPOUNDS	0.001385

## BLDG S1/W1

## =====

PROCESS: 1 FUEL OIL HEAT

=====

CARBON MONOXIDE	0.05915
NITROGEN DIOXIDE	0.21294
PARTICULATE MATTER 10	0.014788
SULFUR DIOXIDE	0.008494
TOTAL PARTICULATE MATTER	0.029575
VOLATILE ORGANIC COMPOUNDS	0.008281

## BLDG S2

## =====

PROCESS: 1 FUEL OIL HEAT

=====

CARBON MONOXIDE	0.008981
NITROGEN DIOXIDE	0.032330
PARTICULATE MATTER 10	0.002245
SULFUR DIOXIDE	0.001290
TOTAL PARTICULATE MATTER	0.004490
VOLATILE ORGANIC COMPOUNDS	0.001257

## BLDG S3

## =====

PROCESS: FUEL OIL HEAT

=====

CARBON MONOXIDE	0.005395
NITROGEN DIOXIDE	0.019421
PARTICULATE MATTER 10	0.001349
SULFUR DIOXIDE	0.000775
TOTAL PARTICULATE MATTER	0.002697
VOLATILE ORGANIC COMPOUNDS	0.000755

## BLDG S5

## =====

PROCESS: FUEL OIL HEAT

=====

CARBON MONOXIDE	0.006333
NITROGEN DIOXIDE	0.022799
PARTICULATE MATTER 10	0.001583
SULFUR DIOXIDE	0.000909
TOTAL PARTICULATE MATTER	0.003167
VOLATILE ORGANIC COMPOUNDS	0.000887

## LOCATION: PIKESVILLE MIL RES ADMIN BUILDING

## =====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.020353
NITROGEN DIOXIDE	0.073269
PARTICULATE MATTER 10	0.005088
SULFUR DIOXIDE	0.002923
TOTAL PARTICULATE MATTER	0.010176
VOLATILE ORGANIC COMPOUNDS	0.002849

## COOPER BUILDING

## =====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.10586
NITROGEN DIOXIDE	0.381096
PARTICULATE MATTER 10	0.026465
SULFUR DIOXIDE	0.015202
TOTAL PARTICULATE MATTER	0.05293
VOLATILE ORGANIC COMPOUNDS	0.014820

## GARAGE 13

=====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.003045
NITROGEN DIOXIDE	0.010962
PARTICULATE MATTER 10	0.000761
SULFUR DIOXIDE	4.37e-4
TOTAL PARTICULATE MATTER	0.001523
VOLATILE ORGANIC COMPOUNDS	4.26e-4

## MERSON BUILDING

=====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.013983
NITROGEN DIOXIDE	0.050337
PARTICULATE MATTER 10	0.003496
SULFUR DIOXIDE	0.002008
TOTAL PARTICULATE MATTER	0.006991
VOLATILE ORGANIC COMPOUNDS	0.001958

## OMS-1

=====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.009428
NITROGEN DIOXIDE	0.033939
PARTICULATE MATTER 10	0.002357
SULFUR DIOXIDE	0.001354
TOTAL PARTICULATE MATTER	0.004714
VOLATILE ORGANIC COMPOUNDS	0.001320

## LOCATION: SALISBURY ARMORY

=====

PROCESS: OIL FIRED BURNER

=====

CARBON MONOXIDE	0.018058
NITROGEN DIOXIDE	0.065007
PARTICULATE MATTER 10	0.004514
SULFUR DIOXIDE	0.002593
TOTAL PARTICULATE MATTER	0.009029
VOLATILE ORGANIC COMPOUNDS	0.002528

## LOCATION: WHITE OAK ARMORY

=====

PROCESS: PROPANE HEATING SYSTEMS

=====

CARBON MONOXIDE	0.02167
NITROGEN DIOXIDE	0.10835
PARTICULATE MATTER 10	0.003251
SULFUR DIOXIDE	0.000650
TOTAL PARTICULATE MATTER	0.003251
VOLATILE ORGANIC COMPOUNDS	0.005743

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13. ABSTRACT (Maximum 200 words) <p>The Clean Air Act Amendments of 1990 (CAAA-90) as well as other Federal, State, and local programs have expanded the requirements to quantify and report the amount of air pollutant emissions released into the atmosphere. The quantification of air pollutant emissions from a commercial facility, such as a military installation, is accomplished by conducting an air emissions inventory (AEI).</p> <p>The Army National Guard of the State of Maryland would like to be proactive with an air emission program. Air Emission Inventories of Maryland National Guard facilities are needed to verify whether the facilities are considered major air pollution sources and therefore need to comply with Title V Permits and Risk Management Plans.</p> <p>This study provides a scientific approach to estimating the air emissions from stationary sources at selected Maryland National Guard sites.</p> <p>Researchers and staff at the Maryland National Guard Environmental Branch selected 13 armories as sites for Air Emissions Inventories. The researchers evaluated a number of methods for quantifying air pollutants and selected "emission factors" as the method of estimating emissions.</p>			
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